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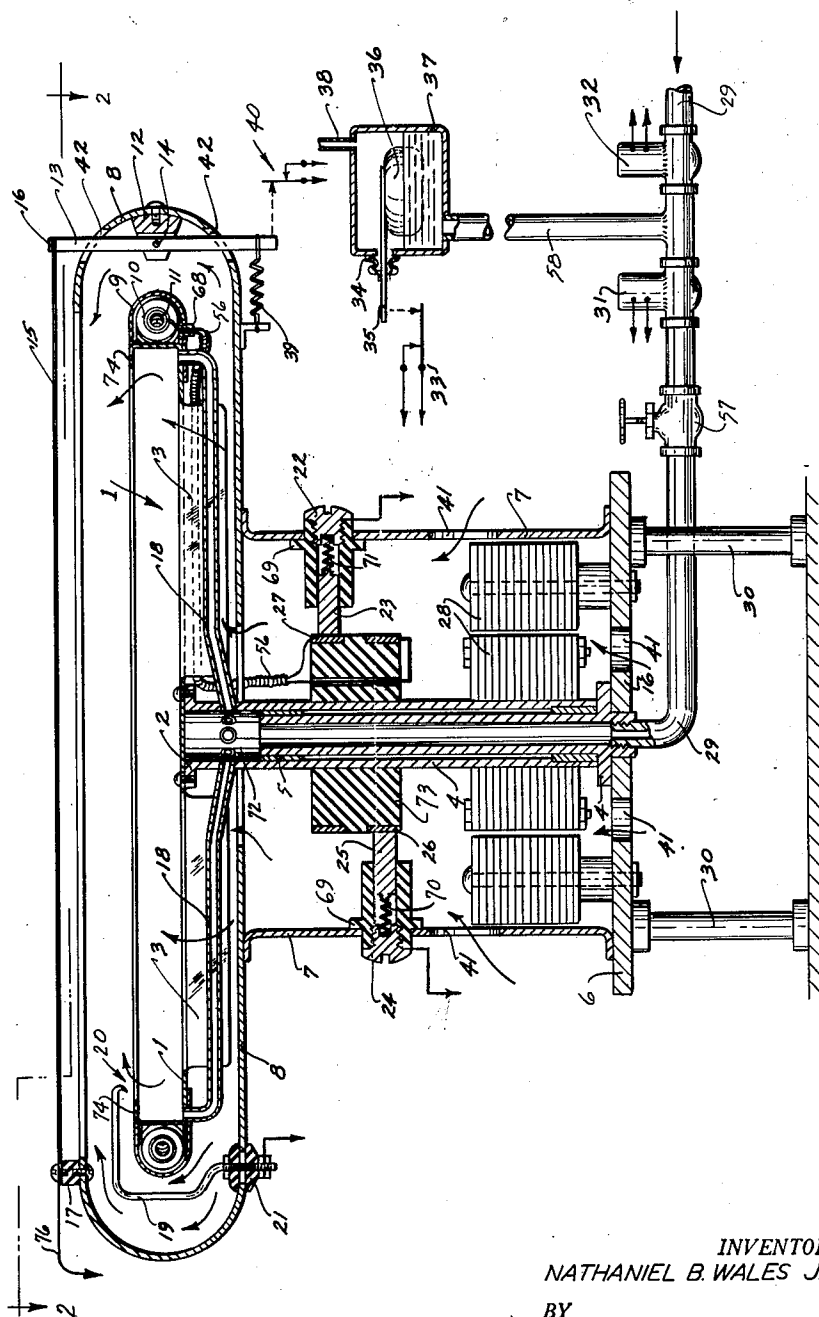
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ROTARY VAPORIZING OIL BURNER

Filed May 7, 1948

3 Sheets-Sheet 1

FIG. 1



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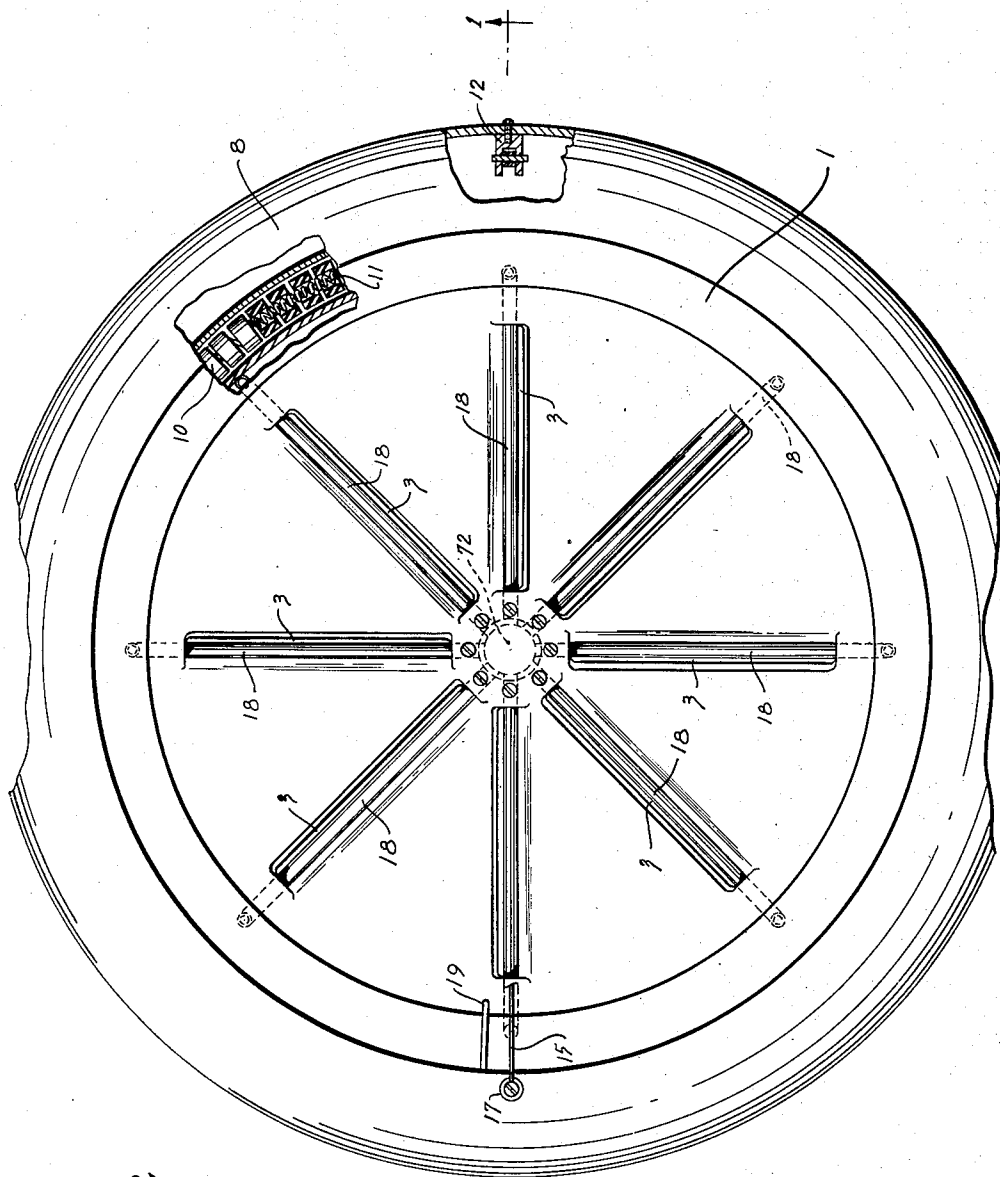


FIG. 2

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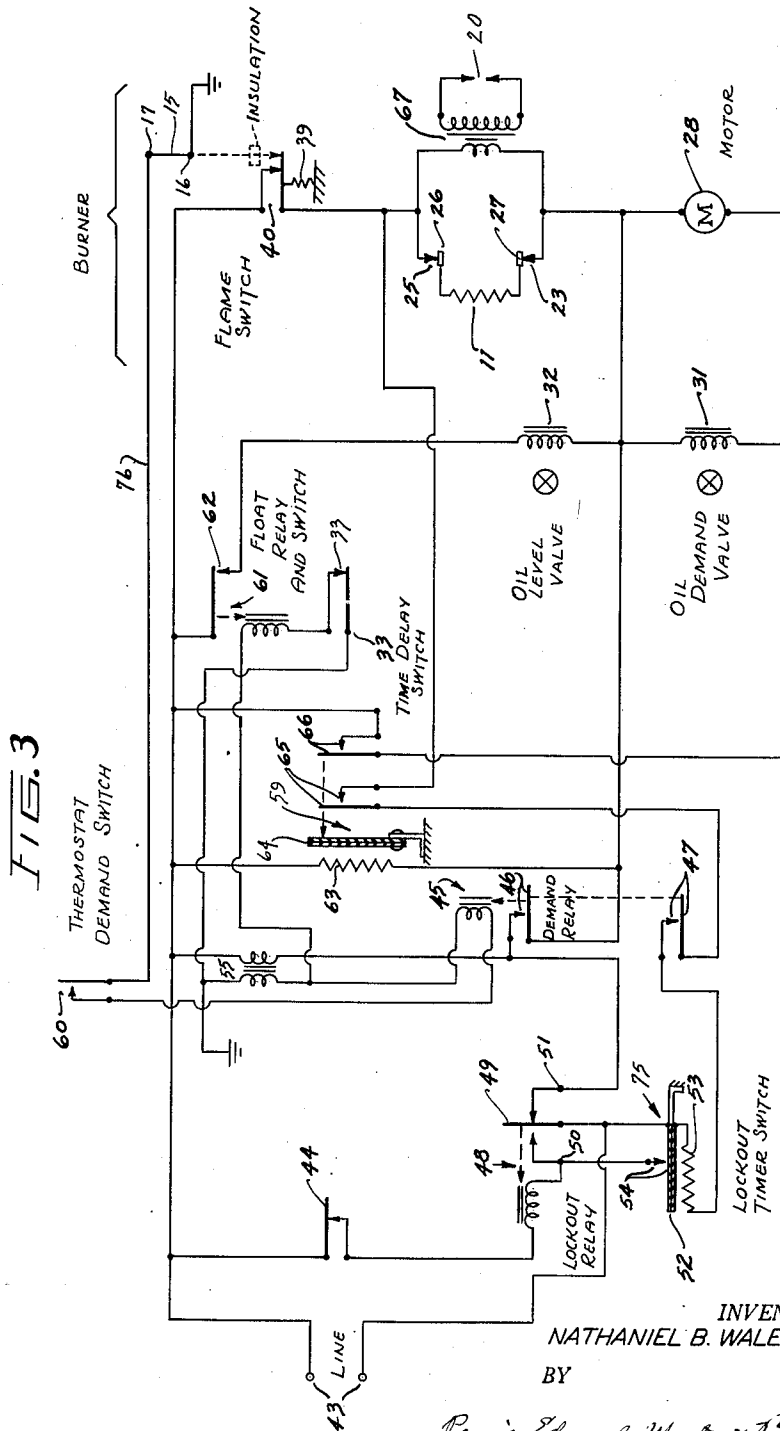
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UNITED STATES PATENT OFFICE

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ROTARY VAPORIZING OIL BURNER

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3 Claims. (Cl. 158—53)

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This invention relates to oil burners and particularly to oil burners in which the oil is vaporized in a rotating retort.

In brief, the invention comprises in an oil burner, the combination of a circular retort supported for rotation on a vertical axis, bearing means to support the retort, said retort being formed with a rim comprising an annular inward peripheral vaporizing surface adapted to carry and vaporize a thin film of oil, oil supply means connected to the inside of said rim, means for rotating said retort so as to form a thin oil film on said vaporizing surface, an oil preheater secured to said rim adjacent said vaporizing surface and having a heat-generating capacity sufficient to vaporize a thin film of oil substantially instantaneously, and means for energizing said preheater.

By permitting no more than a film of oil to form on or be delivered to the vaporizer surface at any time, such a burner can be made to start reliably under automatic control and to achieve a self-sustaining combustion phase within a short time after starting. These requirements are especially important in a domestic type burner installation.

In order to assure that the rotating retort does not collect a body of fluid oil which would defeat the above requirements, the burner according to the invention preferably includes a rotating electrical heating ring associated with the rotating vaporizing retort together with a sequence control unit which causes the vaporizer surface to be preheated to a predetermined vaporizing degree before the initiation of the rotation or admission of fuel oil to the vaporizing retort. Additionally, by forming the air supply blower integral with the rotating retort, and by simultaneously initiating the rotation and oil admission to the preheated vaporizer retort, the initial vaporization and air mixture take place before the rotor has attained high speed and therefore under conditions of low air velocity, which is conducive to reliable ignition.

The foregoing and other features of the invention will be more clearly understood by consideration of the following description taken together with the drawings, wherein:

Fig. 1 is a sectional view in elevation of a preferred embodiment of my invention showing the essential parts of the oil burner proper;

Fig. 2 is a top view of the burner of Fig. 1, omitting certain parts as indicated by the section line 2—2 of Fig. 1, showing the construction of

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the annular vaporizing heater and the disposition of the air vane vents;

Fig. 3 is a schematic wiring diagram of the control system of the invention.

As seen in Figs. 1 and 2, a rotating vaporizer retort 1 of heat-conducting sheet metal is formed so as to comprise an annular vessel capable of centrifugally retaining a film of oil on its inner periphery. Surrounding and secured to the vaporizing surface of retort 1 is an annular metal casing 9 which supports a helical coil of resistance heater wire 11 insulated by ceramic beads 10 strung along the coil, thereby comprising an annular heater element. The terminal ends of wire 11 pass out of casing 9 through ceramic insulating bushings 58. This articulated heater construction permits the heater coil to be properly supported without excessive stresses in spite of the thermal distortions in retort 1 and casing 9 due to large temperature variations to which the burner is subject.

The central disc portion of retort 1 is pierced to form a plurality of louvers or vanes 3 which act both as blower blades and as central air delivery ports. Retort 1 is secured near its axis to hollow shaft 2 which carries bearing sleeves 5 and is supported on vertical sleeve 4. Sleeve 4 is secured to base plate 6 which is in turn supported on legs 30, preferably adjustable as to height. Oil delivery tube 29 connects to the lower end of a central opening in sleeve 4, thereby allowing oil to pass axially up to the top of sleeve 4 and into delivery chamber 72 formed by the inner walls of shaft 2 between the top of sleeve 4 and the bottom of rotor disc 1. A constant level reservoir 37 maintains the static oil level in this chamber at a point intermediate between the top of sleeve 4 and the bottom of rotor disc 1. Oil duct tubes 18 symmetrically spaced radially around the axis communicate between the delivery chamber described above and the centrifugal vaporizing annulus or vessel formed in the periphery of rotary retort 1. As seen in Fig. 2, these tubes pass beneath the louver openings so that the oil in the tubes is cooled by the air stream. They may pass upwardly through the louver openings instead of through separate holes as shown.

Upon rotation of ducts 18 with retort 1 about their vertical axis, centrifugal force lifts the oil from its static level in the delivery chamber 72 and delivers it to the periphery of rotating annular retort 1. Cowl 8 secured by means of the cylindrical casing 7 to base plate 6 cooperates with blower vanes 3 to deliver two air streams to

the combustion area, the one passing around the outside of lip 74 on the intumed peripheral rim of retort 1 between the heater casing 9 and the inside periphery of cowl 8, and the other passing around the inside of lip 74 via the pierced louvers 3 in the rotor disc 1, as indicated by the arrows. This double air flow results in an intimate and homogeneous mixture of the air with oil vapors escaping around the lip of retort 1 since no vapor can emerge without encountering both of these enveloping air streams.

The motor 28 may be of the conventional shaded pole squirrel cage induction type consisting of a stator field structure secured to the base 6 and a squirrel cage rotor concentric therewith and secured to rotating hollow shaft 2. Since the power required need be only sufficient to rotate the retort with its air-impelling vanes, this driving motor may be much smaller than usually required for other oil burners of comparable rating. The intake air ports 41 are positioned to aid in cooling motor 28. To provide electric current to the heater coil 11, slip rings 26 and 27 carried by insulating member 73 on shaft 2, are connected to the respective ends of the heater coil 11 through leads 56 suitably insulated as by ceramic beads, secured to the rotor structure. The insulating brush holders 69 secured to casing 7 carry the brush assembly 24, 70, 25 which bears on ring 26 and the assembly 22, 71, 23 which bears on ring 27. Brush springs 70, 71 provide suitable brush pressure to maintain contact.

The ignition system includes a spark gap 20 between the electrically grounded lip 74 of retort 1 and the tip of electrode 19 which is supported on cowl 8 by the feed-through insulator 21. It is to be noted that, due to the low starting air velocities and the instant vaporization of the initial oil film, only a very moderate intensity of spark is required reliably to ignite the burner. This permits use of an ignition transformer of only about one-tenth the capacity of those required by the gun-type and centrifugal slinger-type burners. A flame switch of fast-action type, incorporated in the burner of this invention, comprises a wire 15 capable of withstanding flame temperatures, stretched diametrically across the top of cowl 8 and secured thereto at one end by the insulating post stud 17. This wire should be of a metal resistant to oxidation at red heat and having a sufficiently high linear coefficient of thermal expansion. Such a material is "Nichrome," nominally of about 75% nickel, 12% iron and the balance chromium with or without small additions of manganese. The other end of flame-switch wire 15 is secured by a screw 16 to the top of lever 13 which is pivoted on pin 14 carried in fork 12 which, in turn, is secured to cowl 8. Thus this end of wire 15 is effectively grounded to the burner. Lever 13 passes through holes 42 in cowl 8 emerging at the bottom to connect with spring 39 secured to cowl 8 so as to maintain the wire 15 under tension. Although lever 13 is shown as passing through cowl 8, it may be secured externally or entirely internally thereof, if desired. In the presence of flame the expansion of wire 15 causes lever 13 to rotate clockwise (as seen in Fig. 1) whereby to open switch 40 which is mechanically coupled to lever 13. Due to the small thermal capacity of wire 15, this system will cause switch 40 to close within a few seconds after the cessation of flame, for any reason, and thus shut down the burner, as explained below. A further safety pro-

vision results from the fact that wire 15 is connected in series in the demand switch circuit, as will also later be explained.

The oil delivery line 29 passes from the burner through the constricting needle valve 57, thence through conventional magnetic demand valve 31 and oil level valve 32 before connecting to the oil supply (not shown). The oil level chamber 37 connects to the duct 58 between valves 31 and 32, and contains float 36 secured to lever 35 supported and effectively pivoted on the bellows type seal 34, thereby permitting chamber 37 to be sealed, although the movement of the float is transferred to the outside of the chamber by the motion of lever 35 to operate switch 33. Chamber 37 is vented by pipe 38.

Referring now to the control system of Fig. 3, it may be seen that the components of the burner proper are represented at the extreme right of the diagram, whereas the remainder of the diagram represents the components more properly included in the control unit. A five-wire cable, plus suitable connections to ground (viz., the burner), connects these two portions of the system.

Electric current from the supply line entering at terminals 43 passes through the normally closed contact leaves 49 and 51 of the lockout relay 48 to energize the primary of the step down transformer 55. The low-voltage secondary of this transformer may be connected by the usually remote, conventional thermostat demand switch 60 to energize the demand relay 45. This action closes the normally open relay contacts 46 and 47. Closure of contacts 46 applies the line voltage from terminals 43 to the electric heater element 63 of a thermal bi-metallic type of time-delay switch 59. The bi-metallic element 64 of this time switch is designed when heated to distort enough to close normally-open contacts 65 and 66 which are actuated by strip 64 after approximately two minutes from the time of closure of relay contacts 46. Simultaneously with the closure of demand relay contacts 46, current is also passed from the line through the vaporizer heater element 11 via the normally (cold) closed flame switch contacts 40 and the slip ring brushes 23 and 25. In addition, current from the line at this time energizes the ignition transformer 67 which is connected in parallel with heater element 11. At the end of the mentioned timed preheating interval, contacts 65 and 66 are closed. The closure of contacts 66 applies current from the line simultaneously to motor 28 and to demand valve 31, thereby bringing oil to the preheated vaporizing retort and initiating combustion due to the existence of a spark as gap 20.

Float switch 33 is arranged to close if oil in the float chamber 37 (Fig. 1) falls below its predetermined level. This closure energizes float relay 61 from the low voltage available at transformer 55, thereby closing normally open relay switch 62 and passing line current through oil-level valve 32 via the demand relay contacts 46. This action opens valve 32 and permits oil from the supply to fill chamber 37 until, at the correct level, switch 33 is again opened, thereby de-energizing valve 32 and shutting off the intake oil flow.

The invention also incorporates a safety lock-out system including lockout relay 48 which is energized by the line through the normally closed push-button switch 44, if the contacts 54 of normally open thermal lockout timer switch 75 are closed. When the conditions necessary to close

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contacts 54 have arisen, relay 48 will be energized and contact arm 49 thereof will break the main line connection through contact 51 and will close contact 50, thus locking itself into energization. By the opening of contacts 49, 51, the rest of the control system will remain de-energized until push-button switch 44 is manually opened, which unlocks the system for re-operation. However, contacts 54 will close only if the flame switch 40 does not open (indicating no flame) for a certain time after contacts 65 have closed, depending upon the predetermined time delay of bi-metallic element 52. In other words, heater 53 for the lockout timer switch receives current only if all the contacts 47, 65 and 40 are closed. This will occur only under abnormal and possibly dangerous starting conditions, viz., when a demand period first causes closure of relay contacts 47, the completion of the preheating period causes closure of contacts 65 and 66, and the absence of flame causes flame switch 40 to remain closed for the specified safety time which is determined by element 52. Push button 44 is preferably located close to the oil burner itself, so that it is necessary for someone to be physically present at the location of the burner where he can observe its condition before he can restore operation of the burner. If the conditions are not normal, the burner will stop shortly after the push button is released.

Operation

The operation of the system of my invention is as follows: On closure of the thermostat demand switch 60 the vaporizer retort 1 is preheated for a time determined by timer 64. At the end of this period the demand valve opens and torque is applied to the rotor by motor 28. As the rotor 1 picks up rotational speed, centrifugal force delivers oil to the hot vaporizer annulus in the form of a thin film where it vaporizes substantially instantaneously. Simultaneously, air is delivered at low velocity to the generated oil vapor by the blades 3. Ignition takes place at spark gap 20 due to the presence of a combustible mixture having sufficiently low vapor velocities as to allow attainment of ignition temperature at the spark gap.

After ignition the rotor picks up speed and the air and oil delivery increase proportionally until the flame has its maximum intensity. When the flame has heated the flame wire 15 to a high enough degree, switch 40 opens thereby de-energizing both heater 11 and the ignition transformer 67, and at the same time disabling the lockout safety system. At this point sufficient radiant heat is delivered by the flame back to the surface of retort 1 to maintain its temperature at the vaporizing point without the assistance of heater 11, and the system has reached the self-maintaining stage. At the end of the demand period, switch 60 opens, thereby de-actuating relay 45 which closes demand valve 31 and removes the supply of current to motor 28.

Due to the fact that all the cooperating components of the system of this invention including the constant oil level device 37, the needle valve 57, the centrifugal lift ducts 18, and the constantly heated retort 1 have operated to sustain no more than a thin film of oil on the retort surface, the closure of the demand valve leaves oil enough to support combustion only for a few seconds and the air flow for this short period is supplied by the angular momentum remaining in the rotor after removal of the motor torque.

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This results in a clean, smokeless termination of the burning cycle. In addition, the subsequent air supplied by this after-rotation or power-off spinning while the retort is still very hot completes the combustion of the non-volatile components of the oil which had been centrifugally retained in the retort and which prior to this time had not had opportunity to undergo combustion. This periodic self-cleaning of the non-volatile products is an important feature of the invention because without it a burner of the vaporizing retort type will accumulate a residue of non-volatile products until the burner becomes inoperative.

In the rare event that wire 15 breaks, the demand switch circuit will be opened, because, as shown in Fig. 3, wire 15 is connected in series with demand switch 60 through lead 76. Thus failure of wire 15 will automatically shut down the burner by restoring all the controls to non-operating condition. If after breaking, wire 15 should fall so as to touch the oil burner proper or the casing, the connection through lead 76 would not ordinarily be completed, first, because wire 15 is of very light weight and would, therefore, rest lightly on the surface which it touched. Secondly, the grounded parts of the burner are normally coated with enamel, a carbon deposit, an oxide or other substance of very high resistance. As a result, at the voltage employed, the current which could pass through such a high resistance contact would be insufficient to operate the demand relay 45. However, by a slight modification of the circuit connections spurious operation of the demand relay 45 may be completely avoided. For example, terminal point 16 (Fig. 1) may be insulated from lever 13 and directly connected by insulated wire to the upper side of the secondary of transformer 55 (Fig. 3) omitting the ground connections in the flame switch circuit which would then become unnecessary.

I claim:

1. In an oil burner, the combination of a circular retort supported for rotation on a vertical axis, bearing means to support said retort, said retort being formed with a rim comprising an annular inturned peripheral vaporizing surface adapted to carry and vaporize a thin film of oil, oil supply means connected to the inside of said rim, means for rotating said retort so as to form a thin oil film on said vaporizing surface, an oil preheater secured to said rim adjacent said vaporizing surface and having a heat-generating capacity sufficient to vaporize a thin film of oil substantially instantaneously, and means for energizing said preheater.

2. The combination according to claim 1, characterized in that said retort is comprised of thin, heat-conducting metal, said preheater comprises a circular electric heater coil covered by articulated insulating beads, and a supporting casing encloses said articulated coil and secures the same in heat-conducting relation to said rim behind said oil-vaporizing surface.

3. The combination according to claim 1, characterized in that said retort is comprised of heat-conducting material, said preheater comprises an electric heater coil, and a supporting casing encloses said coil and secures the same in heat-conducting relation to said rim behind said oil-vaporizing surface.

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